Patho presentation, 2017-06-12

Client-side Machine Learning
(!! in the Browser !!)

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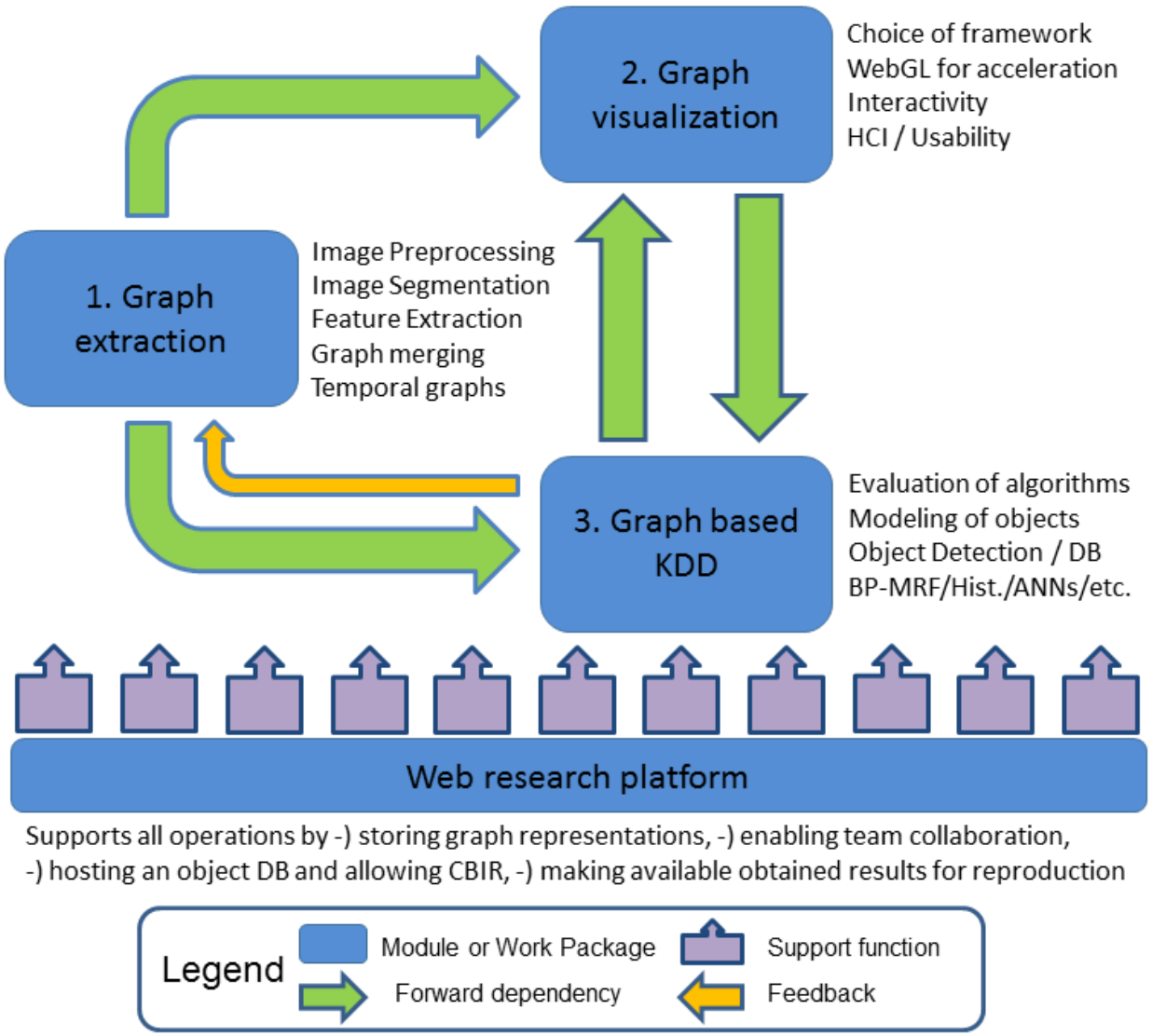
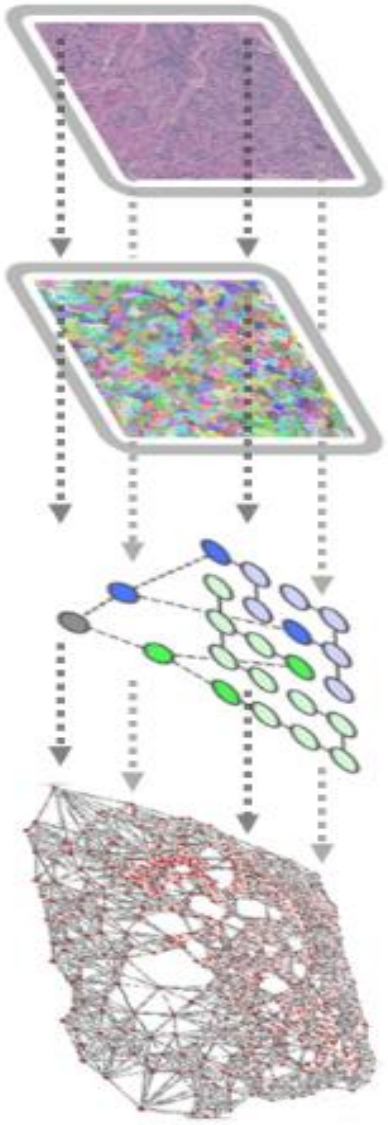
Introduction / TOC

1. History: How did we get the idea?
2. Advantages of client-side ML
3. Problems of client-side ML
4. Google federated learning…
5. How does it fit with big data ???
6. DEMO
   - Graph extraction from images
   - 3D Graph visualizations
   - LOLA…
7. Future work

How did we get the idea? – Back in 2014.....



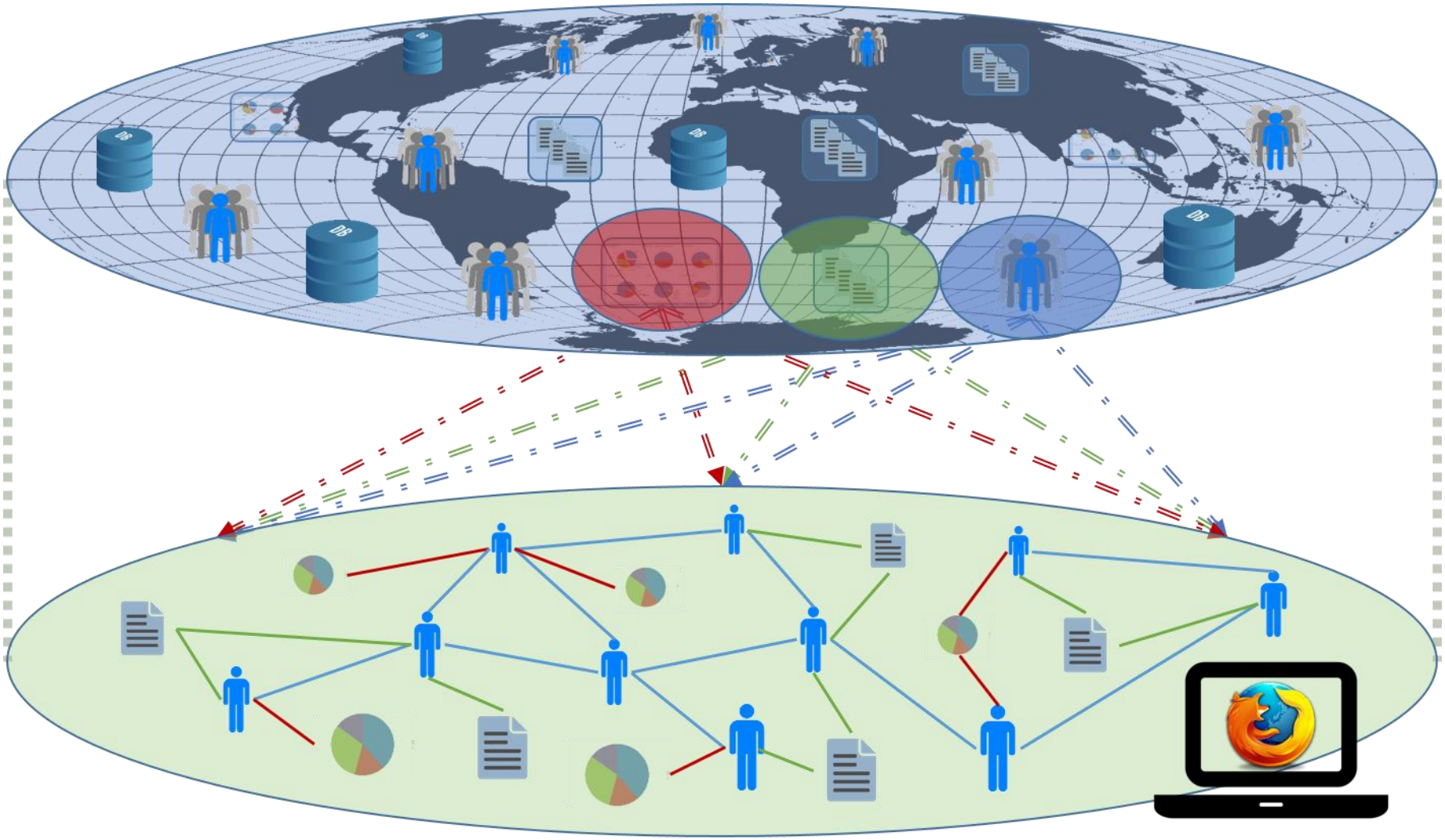


Advantages of client-side ML

1. Huge Processing power ubiquitous today
   - iPhone 6 is 120,000,000 times faster than the best Apollo-era computers…
   - Browser JSVMs almost as fast as native code (within an order of magnitude)
2. (Almost no) scaling factor
3. Self-configuring from the outside
4. Updates are trivial
5. Access to personal information during learning, but not necessary to store in a DB (context-aware)
6. Safer than locally installed software !!!
   - Sandbox model (at least in browser)
7. Globally distributed grid computing

Motivation: The local sphere (idea)

The global / local sphere (idea)



Problems of client-side ML

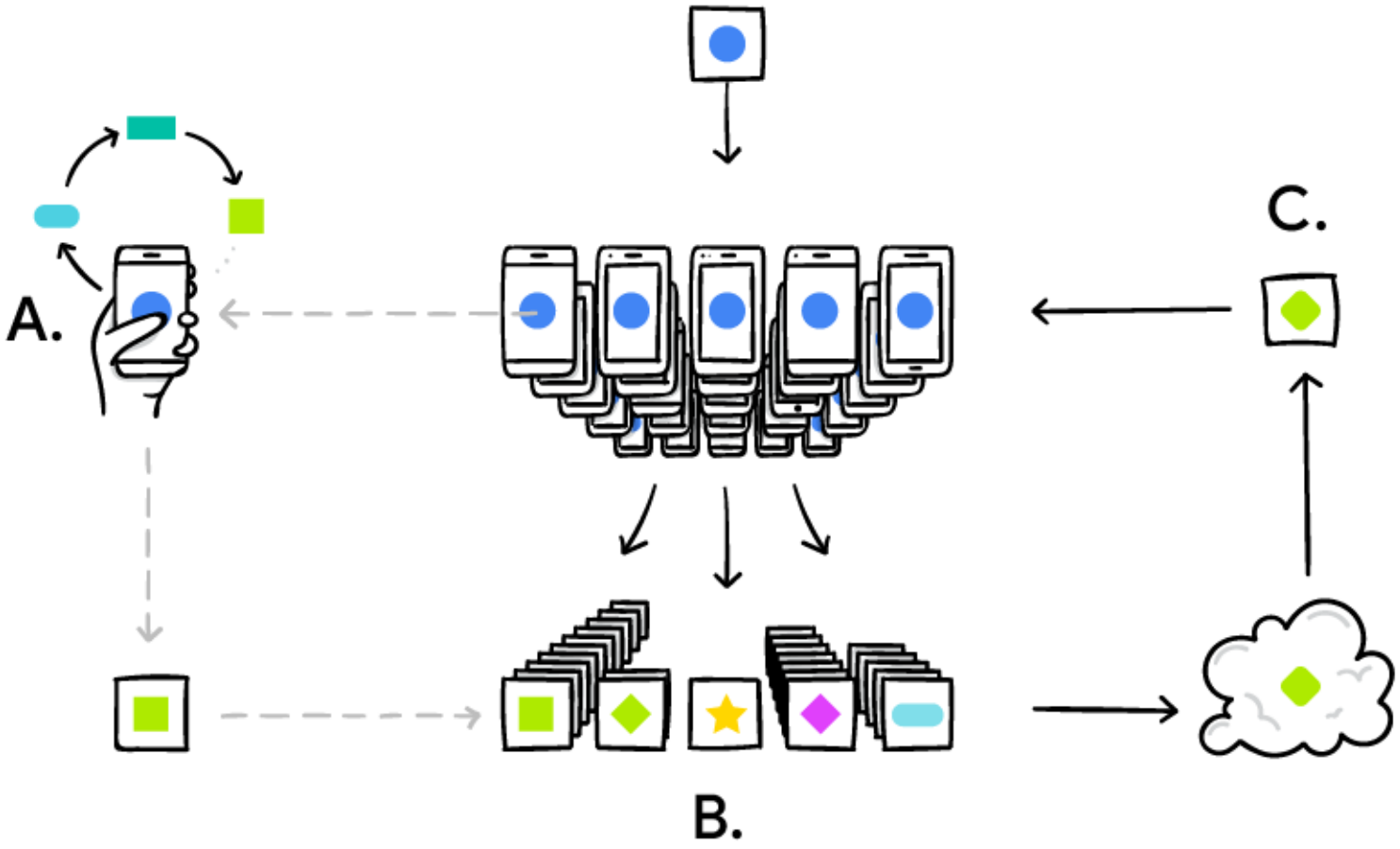
1. Still much slower than highly optimized libraries which have been developed over decades

2. High network latency

3. Low network bandwidth

4. Only small data (up to hundreds of MBs) realistic on a phone / in a browser

Google federated learning (2017/04)

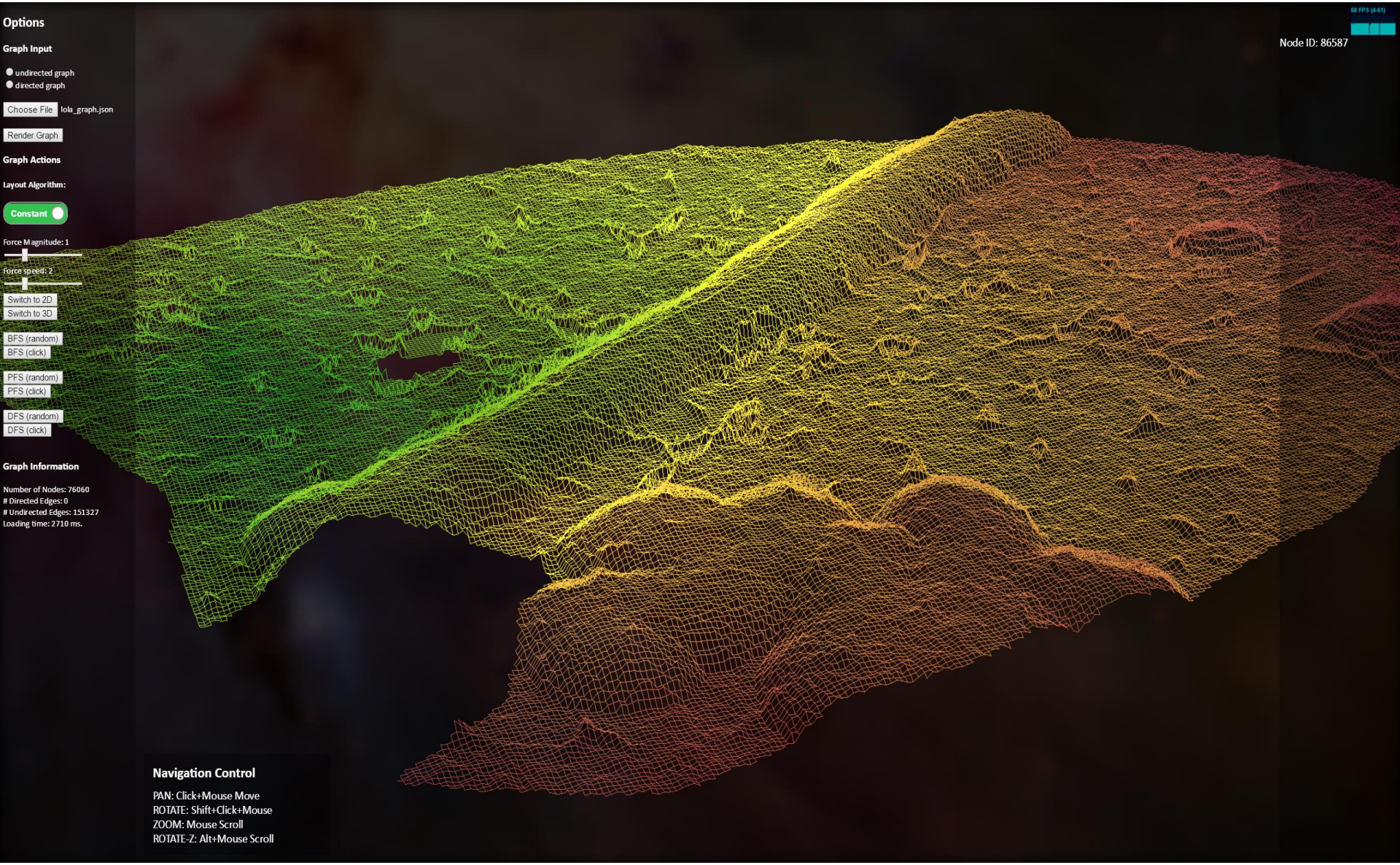


Source: https://research.googleblog.com/2017/04/federated-learning-collaborative.html

How does it fit with BIG DATA ???

- Often, individual sets of data are not huge, even if their total collection is in the Peta-bytes
  - Like patho images !!
- Learn a model globally, use it locally
- Imagining each client as a personalized sub-sample of the global population, the whole systems starts to look like a bagging-approach (without random sampling)
- Update model locally, average model globally

DEMO !



Input source: Nicola Giuliani / LBI

Future work

- The need for speed:

ALL-10-FOLD-AVG	MinCut graph-50	MinCut graph-100	MinCut graph-150
Native C++ GCC	619	11068	65227
Native C++ VS	637	4129	10087
ASM.js Node	1143	3249	119323
ASM.js Chrome	809	2624	120450
WASM Chrome	682	2400	112353
ASM.js Firefox	708	2406	117550
WASM Firefox	610	2074	108537
ASM.js Edge	987	3267	132141
WASM Edge	1106	3666	148301

- Deriving collective intelligence out of individual insights

- Persuading decision makers that the era of client-side Machine Learning is upon us !

Thank you!